



Comparison of GPS and AIRS TPW

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Overview

- Motivation
- Instrument Essentials
- Matched Data Set Preparation
- Results
- Conclusions



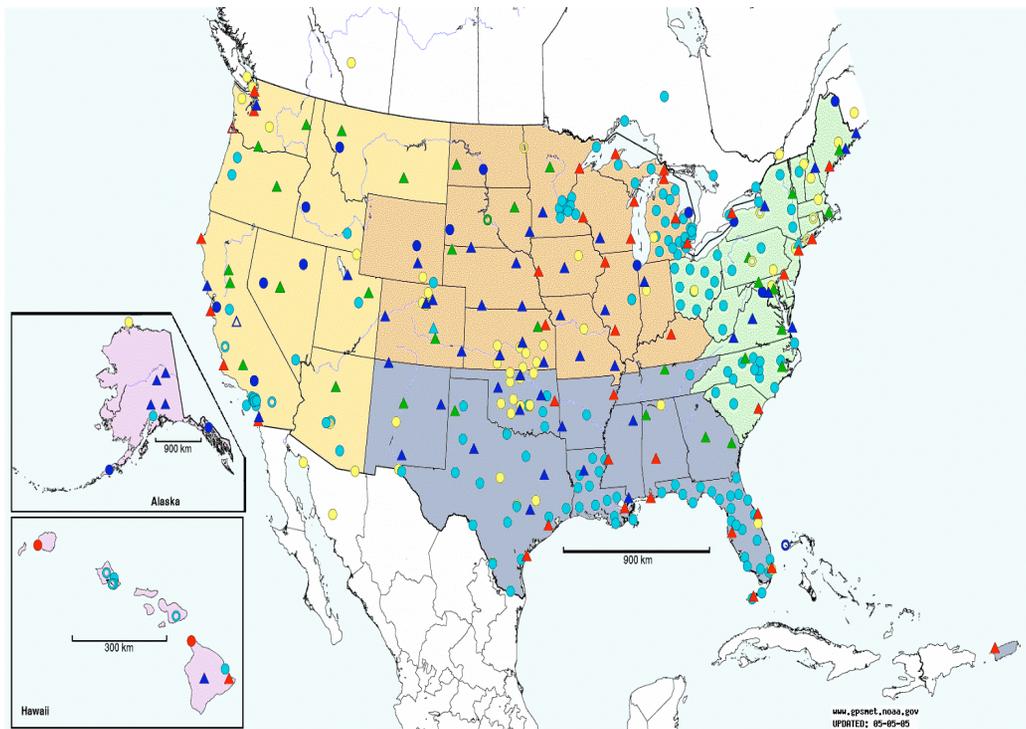
Motivation

- AIRS was designed to advance satellite sensing of water vapor significantly
 - Forerunner of improved operational sounders, including CrIS, IASI, HES
- Validation of AIRS water vapor products essential
 - Permit use of products for hydrology, climatology
 - Provides additional confidence in quality of water vapor channel radiances for NWP data assimilation



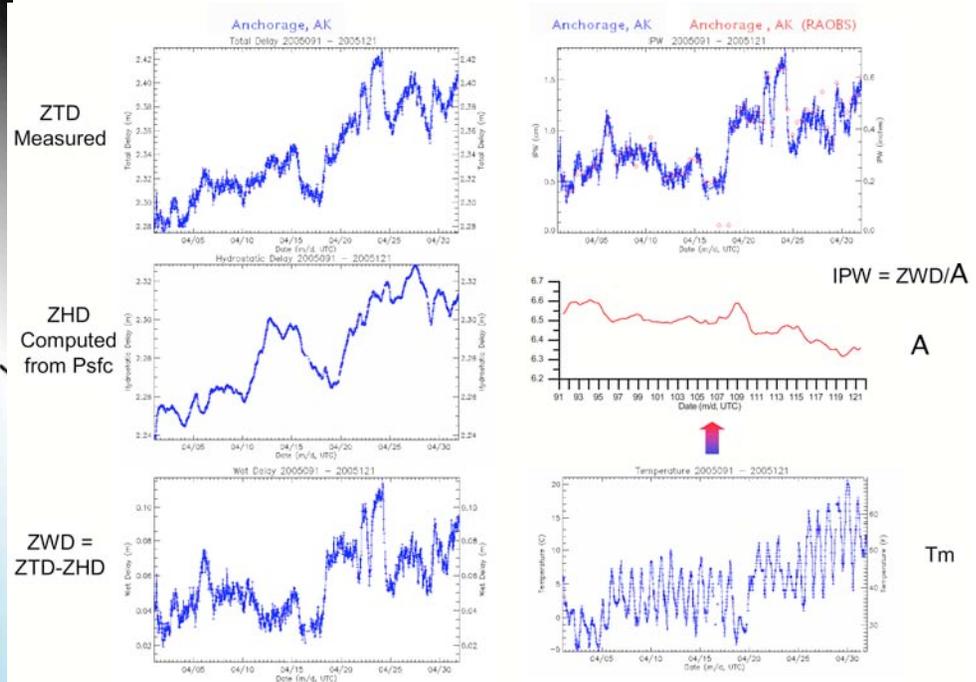
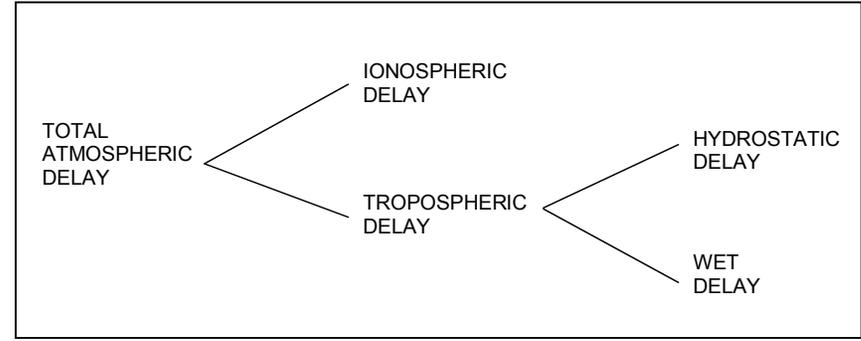
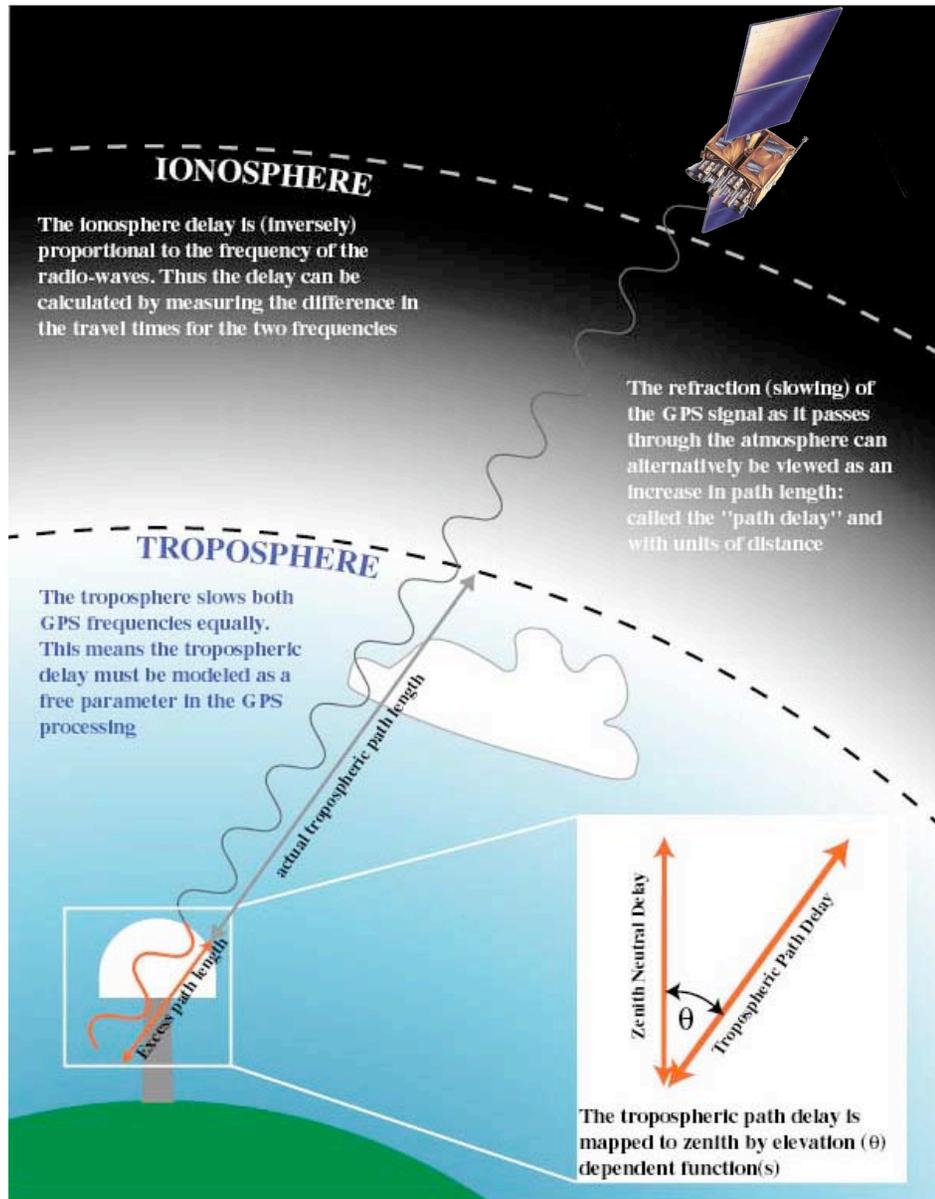
Why GPS for AIRS Validation?

- Accurate column IPW
 - (But no insight on vertical distribution)
- All CONUS Coverage
 - Over 300 stations
- Operational, with 30 minute refresh
- Can accumulate statistically significant data sets quickly and easily





GPS-IPW Measurements





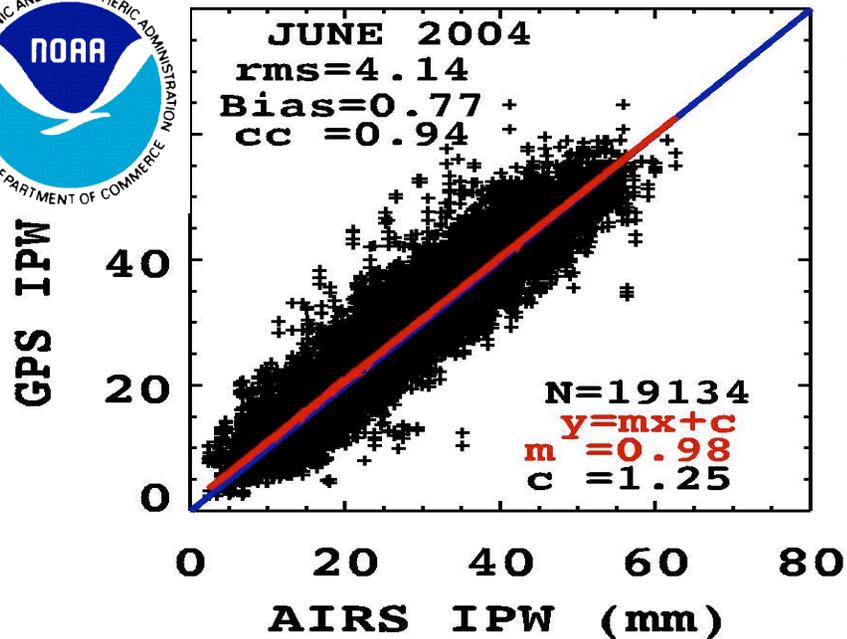
Data Set Preparation

- **Period of Study April – October 2004**
- **Initial Spatial Window is 0.5 degree by 0.5 degree**
- **Later 0.25 by 0.25 degree match-up also were studied**
- **Temporal Window is half hour**
- **A (GPS-AIRS) IPW match-up is formed when there are un flagged values of:**
 - (a) GPS IPW**
 - (b) AIRS IPW**
 - (c) GPS Surface Pressure**
 - (d) AIRS Surface Pressure**

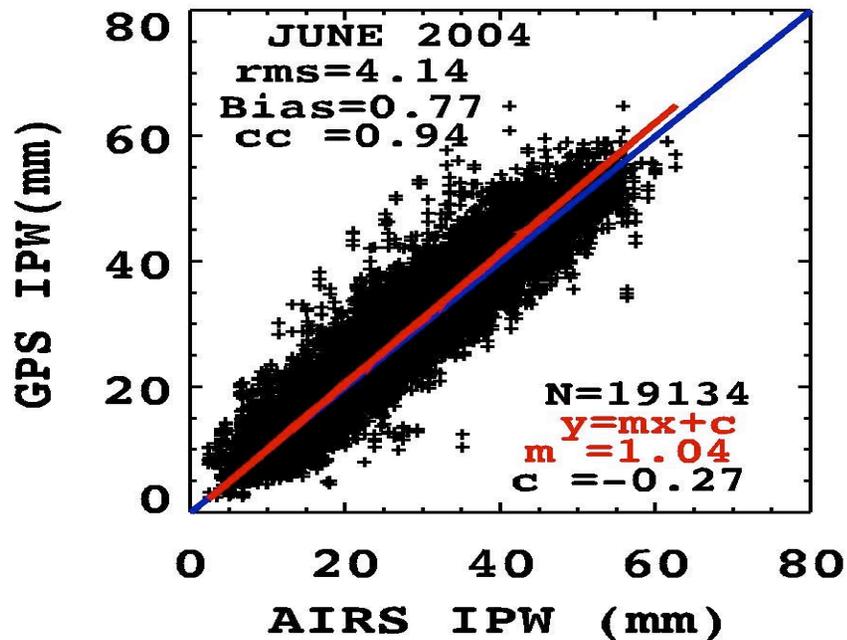
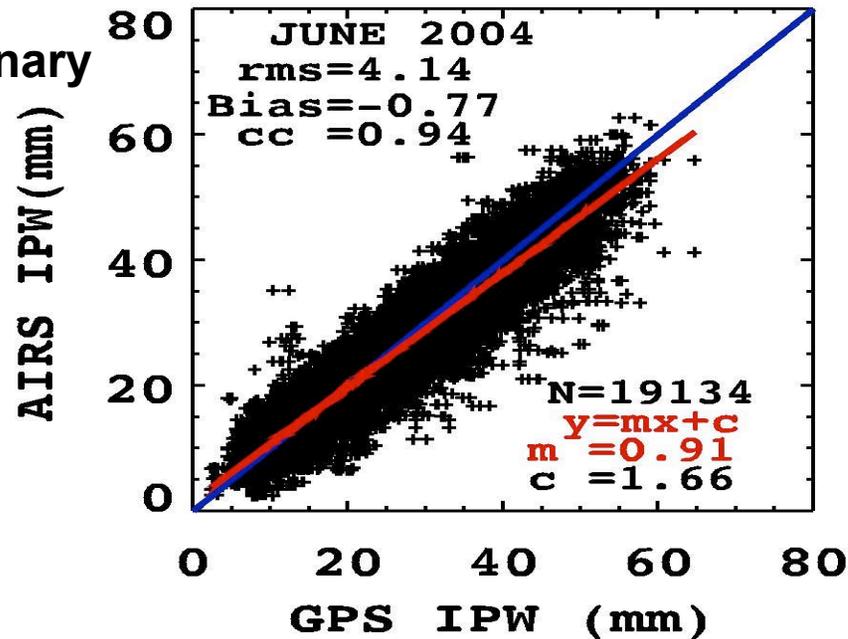


Data Set Preparation

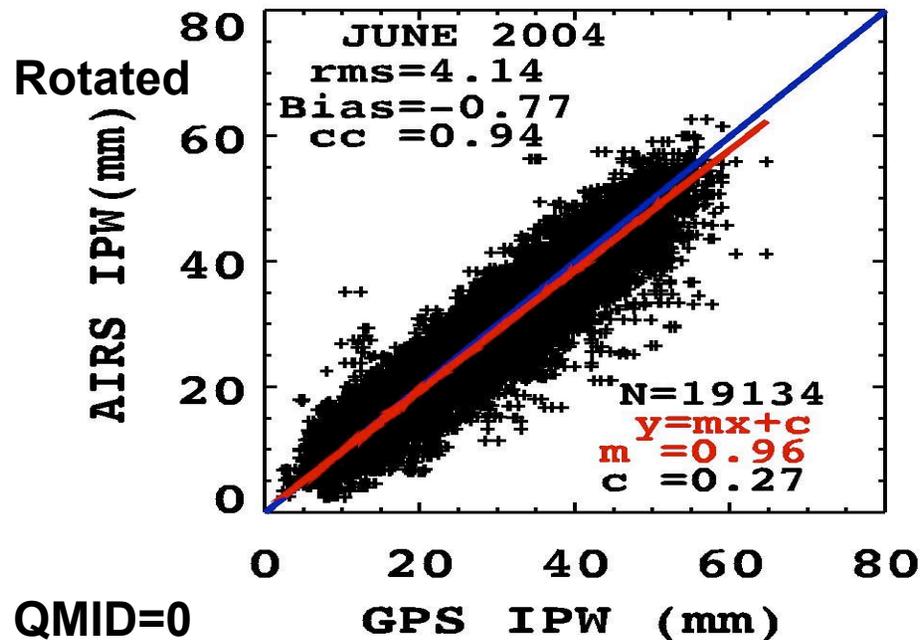
- **AIRS data from JPL had two Quality Flags**
 - (a) QBOT = 0 flag
 - (b) QMID= 0 flag
- **The values “0” indicates high confidence i**
- **QBOT =0 flag is more stringent than QMID =0 flag**
- **Generally the match-up with QBOT=0 is a subset of those with QMID=0 data**
- **The specific criteria for QBOT and QMID flags are detailed in Susskind et al. (2006, JGR Special issue on AIRS)**



Ordinary



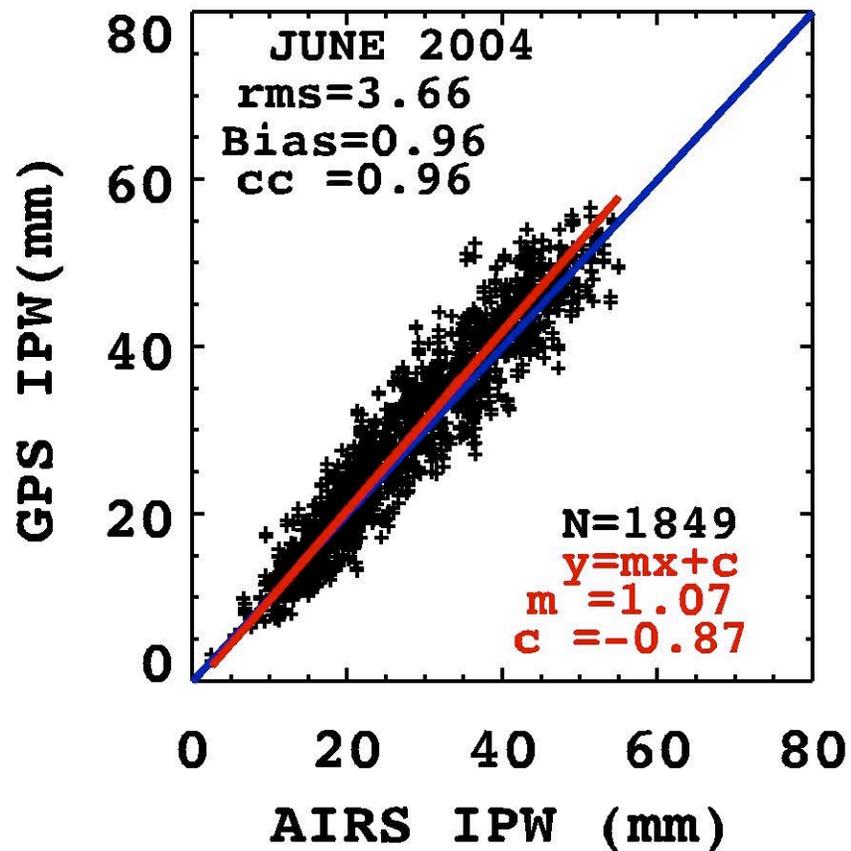
Rotated



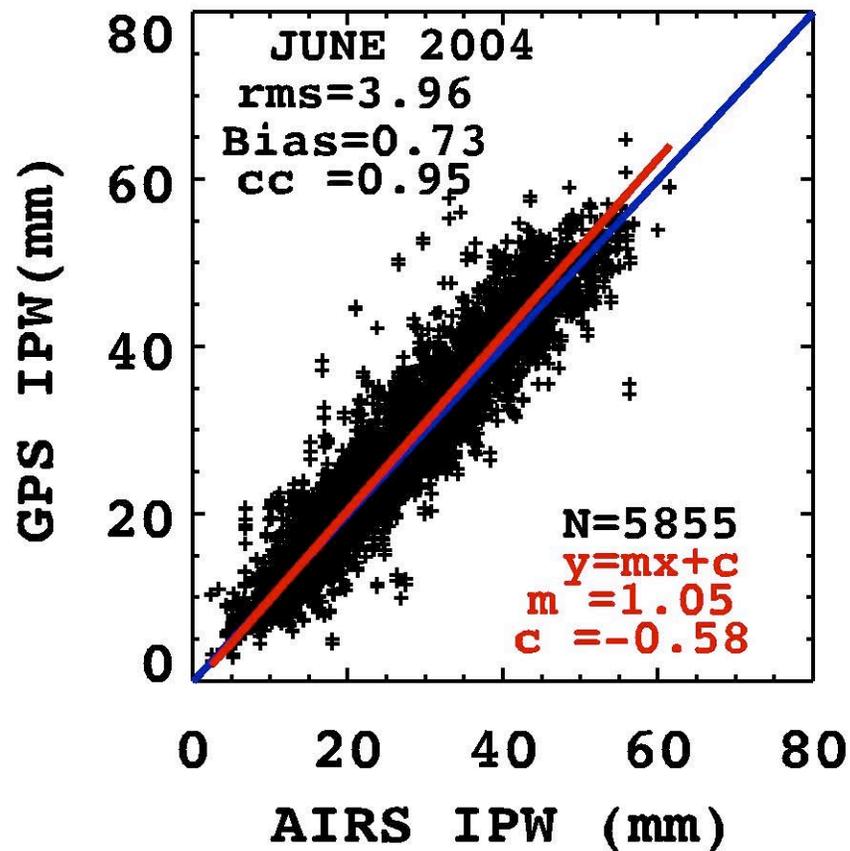


1/4 degree match-ups

QBOT=0



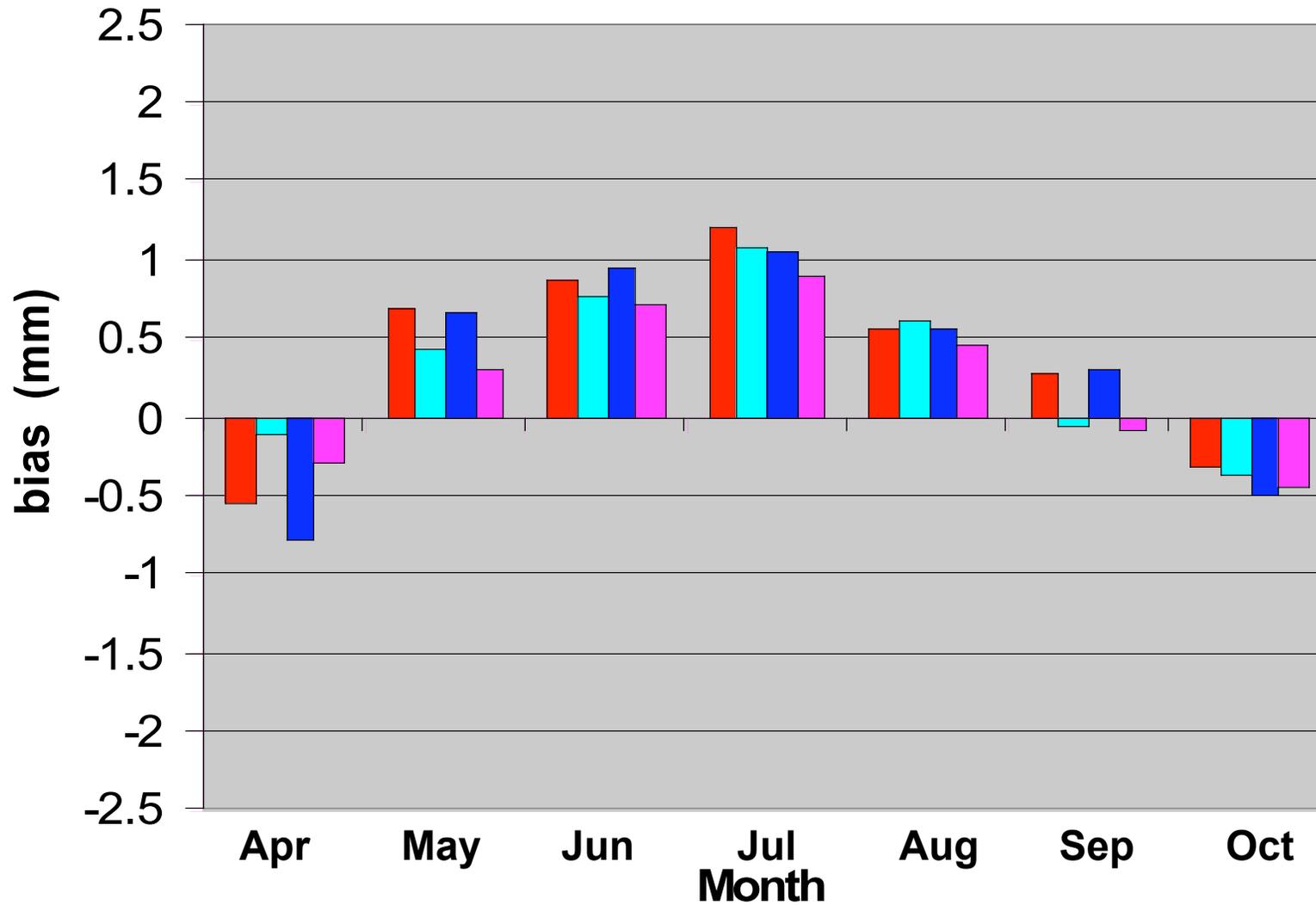
QMID=0





(GPS-AIRS) bias as a function of time

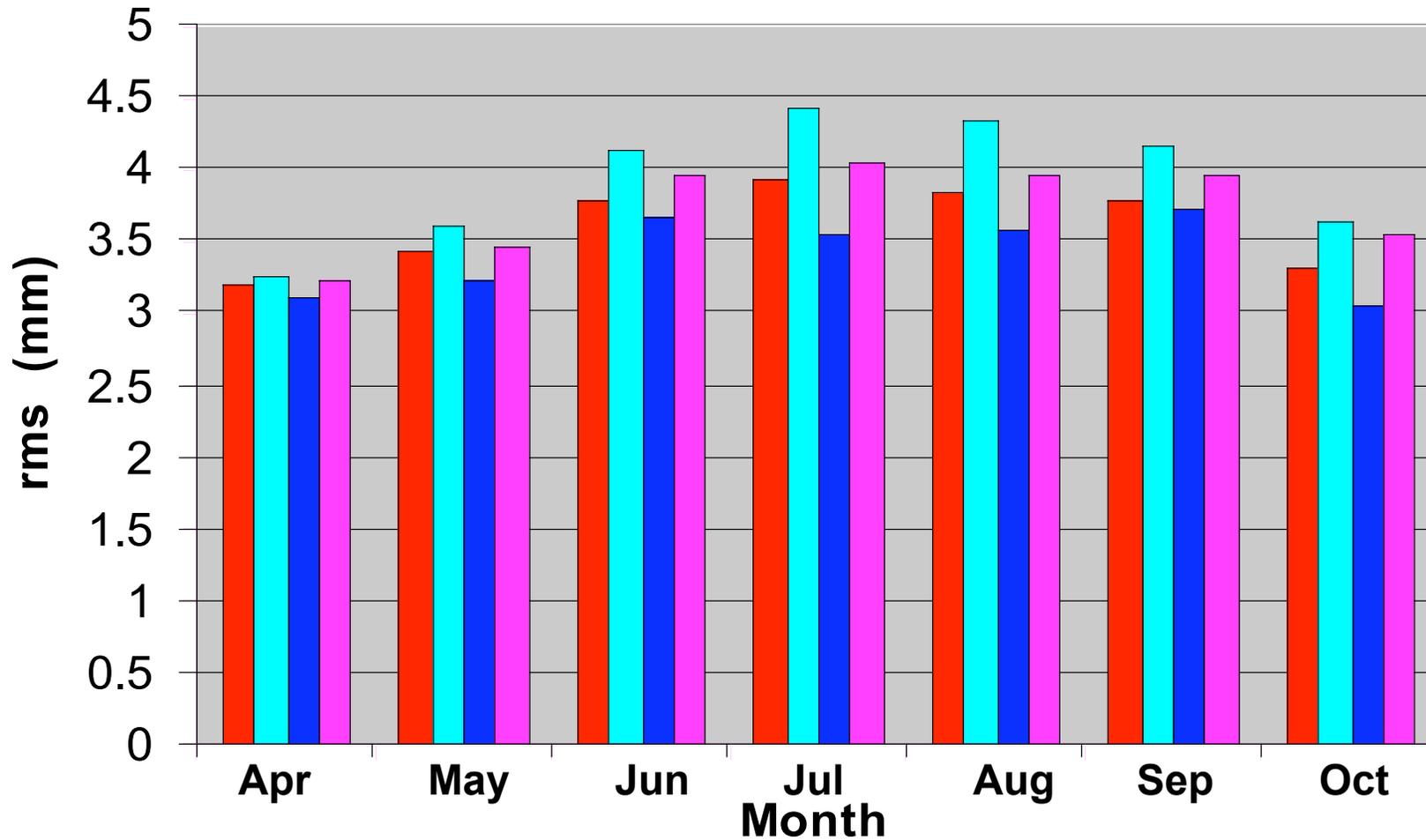
- 1/2, QBOT=0
- 1/4, QBOT=0
- 1/2, QMID=0
- 1/4, QMID=0





(GPS - AIRS) rms as a function of time

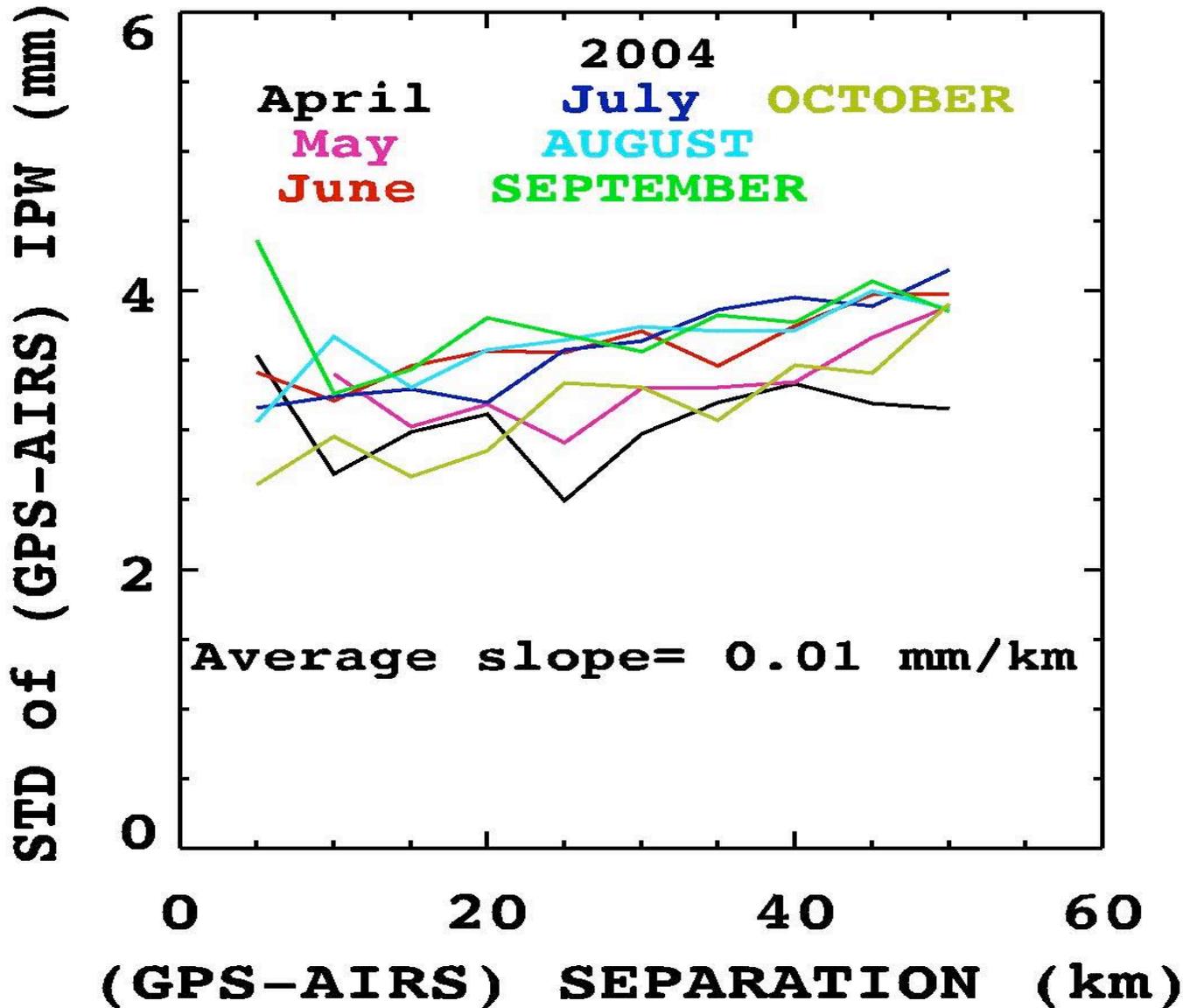
■ 1/2, QBOT=0 ■ 1/2, QMID=0 ■ 1/4, QBOT=0 ■ 1/4, QMID=0





Stdev of IPW diff Vs Separation

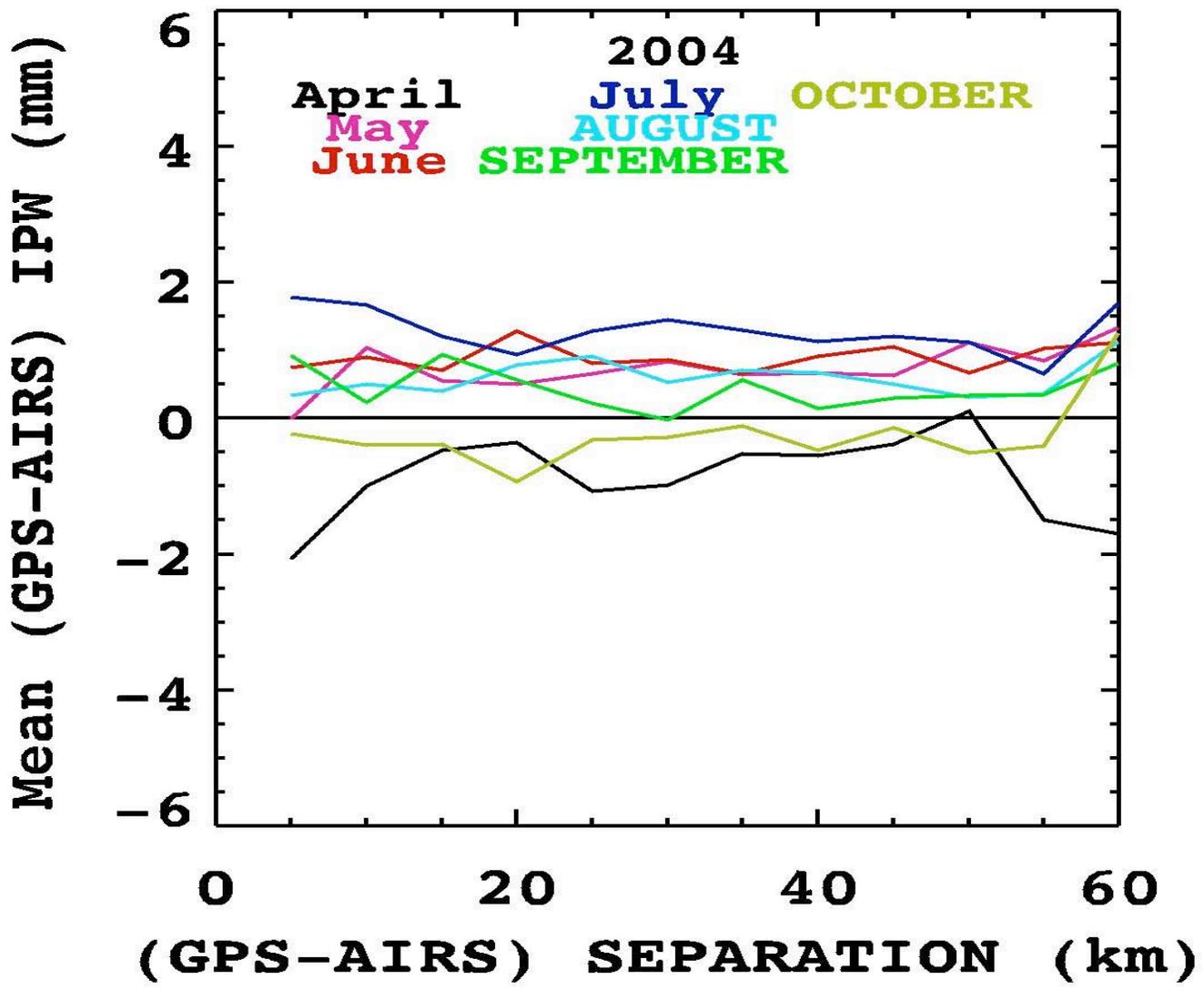
QBOT=0





Mean IPW difference Vs Separation

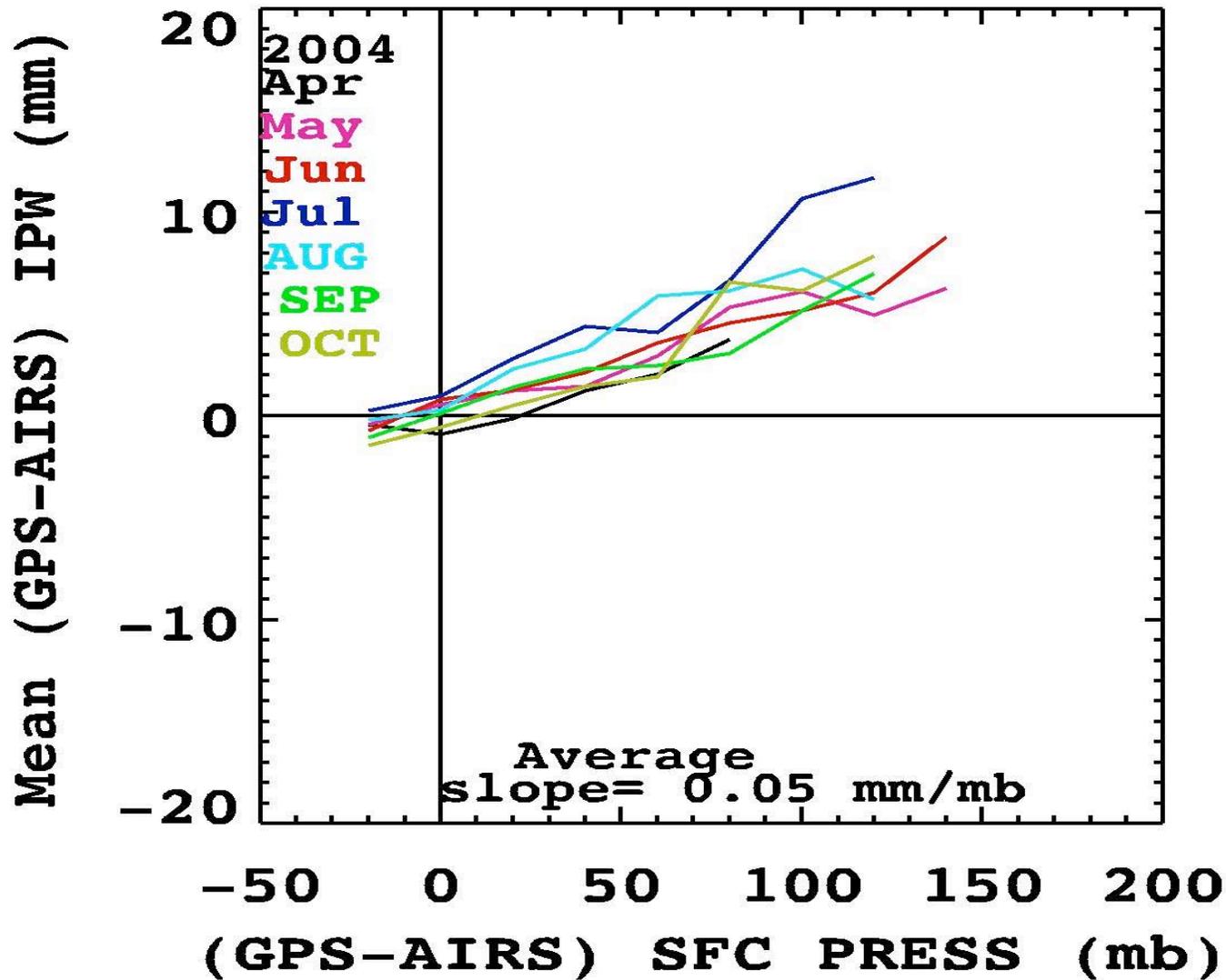
QBOT=0





Mean IPW difference Vs Mean surface pressure difference

QBOT=0





Surface pressure difference based adjustment to AIRS IPW

- **The average slope and intercept values from the previous chart used for corrections to AIRS IPW based on the surface pressure differences between the two measurements**
- **Some typical (GPS-AIRS) bias values in mm units given in the table for QBOT flag data with and without adjustment**

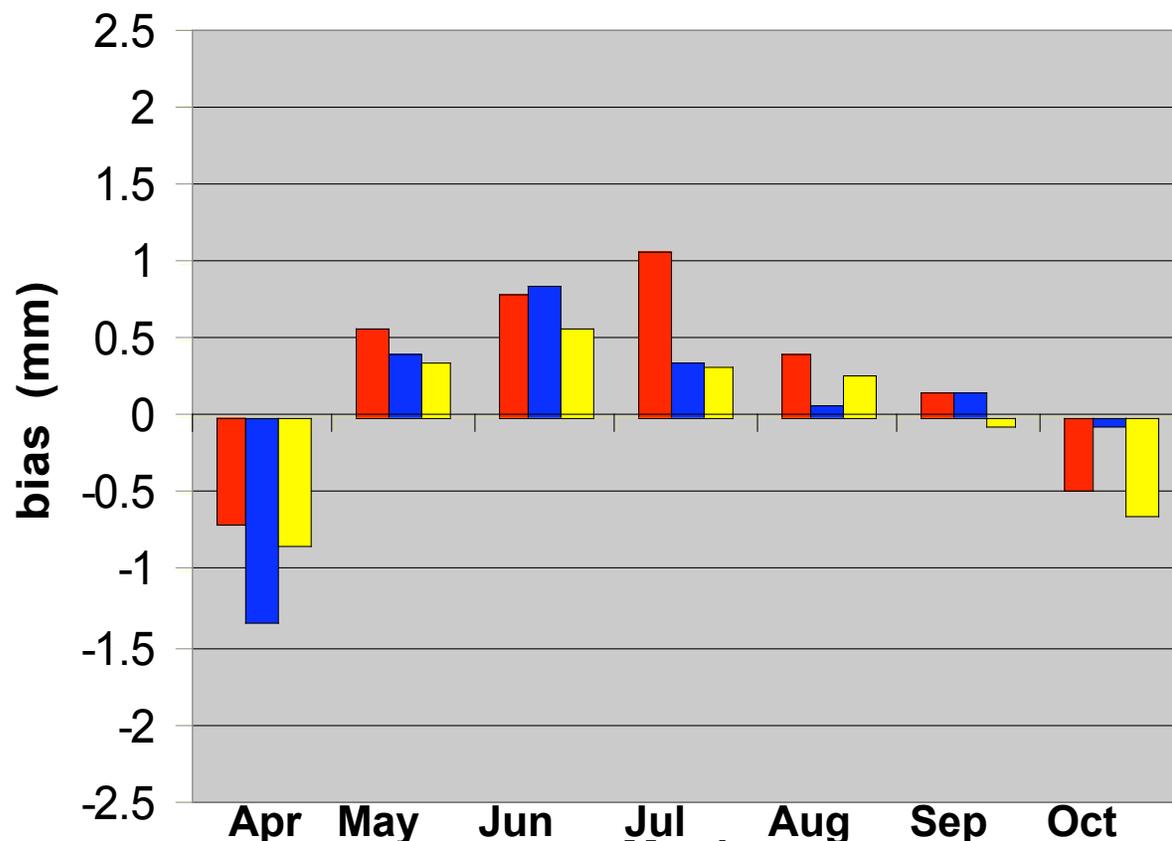
Month	QB	QBadj
May	0.70	0.35
Jun	0.87	0.51
Jul	1.21	0.42
Aug	0.58	0.35



Surface pressure difference based correction to AIRS IPW

(GPS-AIRS) bias as a function of time

- 1/2, $\text{deltap} \leq 20$, QBOT=0
- 1/2, $\text{deltap} \leq 0.5$, QBOT=0
- 1/2, sfp adjusted



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All Science Team Meeting,
Greenbelt, MD



Summary

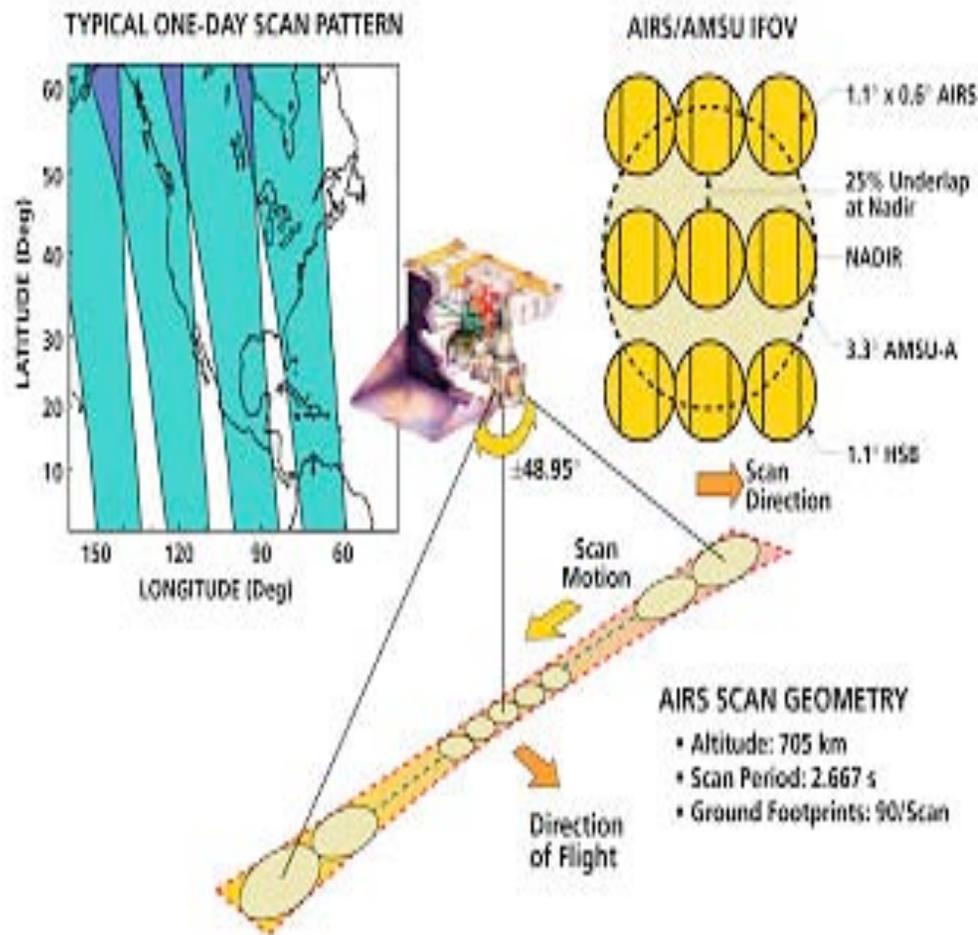
- AIRS and GPS data show remarkable agreement in Integrated Precipitable Water (IPW)
 - (a) Confidence in AIRS Retrieval algorithm;
 - (b) Confidence AIRS water vapor channel radiances
 - (c) GPS IPW can be used as a validation tool for any satellite based IPW retrievals (for example CrIS, IASI, HES, etc.) – IFF GPS IPW network is there
 - (d) Quick and repeatable sanity check
- Seasonal dependency evident in GPS-AIRS bias and rms differences
- The delta sfp affects delta IPW. This dependency can be used for partial bias correction.

Back-up Slides

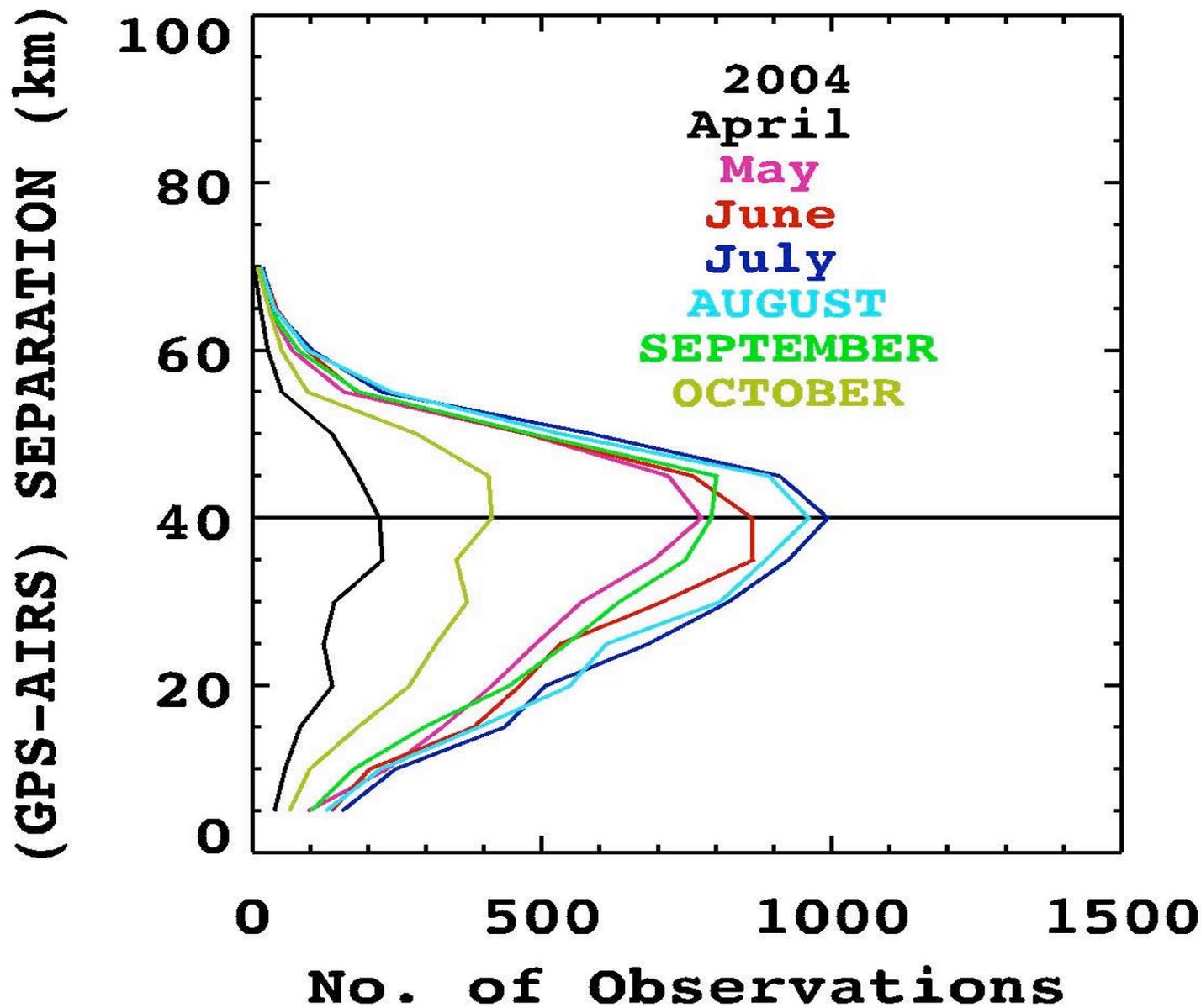


AIRS

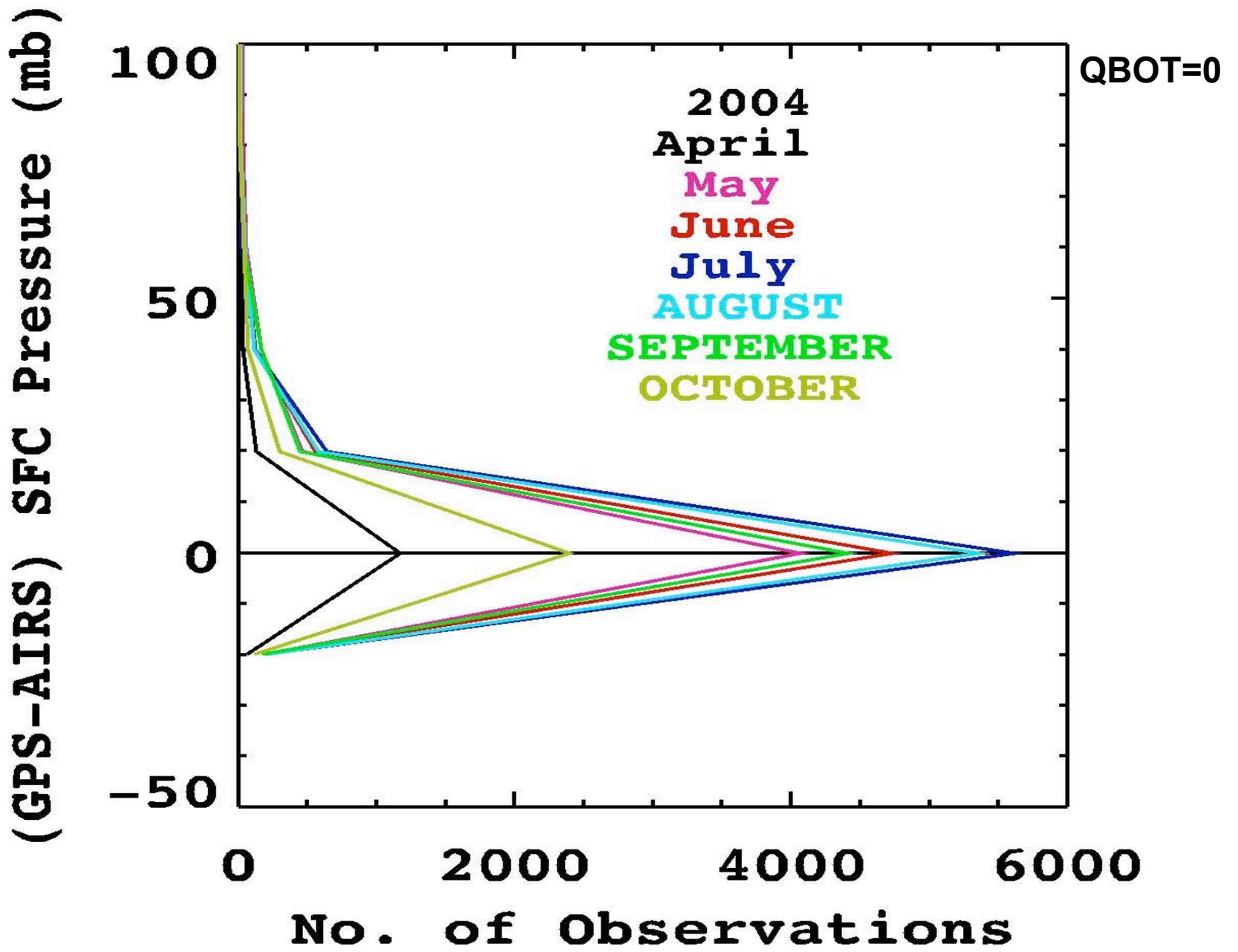
- **EOS AQUA MISSION**
AIRS, AMSU-A
and HSB
- **Coverage (vert. S-40 km)**
- **High resolution**
1km (vertical trop.)
3-5 km (vertical strat.)
13.5 km (horizont)
- **Temp., humidity, SST,**
O₃, CO, CO₂, CH₄, N₂O,
SO₂, fr cloud, etc.



Courtesy: Aumann et al. (2003)



QBOT=0



Greenbelt, MD